C
Oh3nZe
1921/22

OHIO NORTHERN UNIVERSITY BULLETIN

ADA, OHIO

APRIL, 1921 Entered as second-class matter July 3, 1907, under Act of July 16, 1894 New Series. Vol. XIII., No. 6

UNIVERSITY OF ILLINOIS LIBRARY
NOV 17
THE LIBRARY OF THE UNIVERSITY OF ILLINOIS

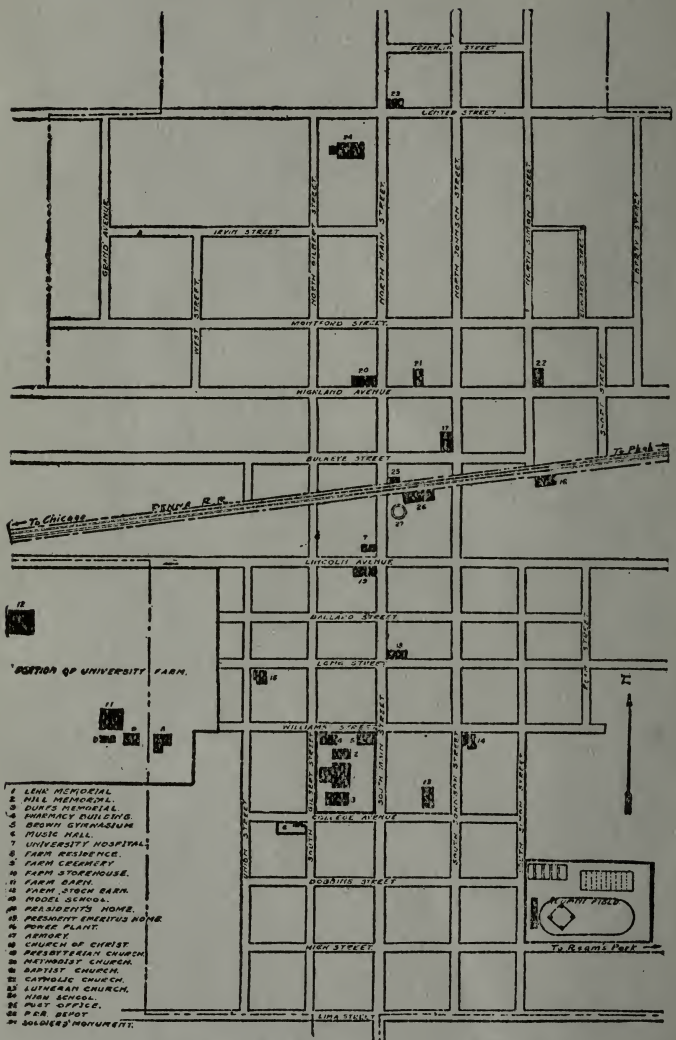
This Bulletin contains information concerning the

COLLEGE OF ENGINEERING

CALENDAR

Fall Quarter------Sept. 5, 1921
Winter Quarter---Nov. 28, 1921
Spring Quarter---Feb. 27, 1922
Summer Quarter-May 29, 1922

President's Office
Univ. of Illinois
Urbana



ADA AND THE O. N U.

ADMINISTRATIVE OFFICERS

ALBERT EDWIN SMITH, D. D., Ph. D.,
President

JOHN DAVISON, M. S., Ped. D.,
Vice President

THOMAS J. SMULL, C. E., Eng. D.,
Executive Secretary

MARGARET E. WHITWORTH, B. S.,
Registrar

COLLEGE OF ENGINEERING FACULTY

CARROLL RUSSELL ALDEN, E. E., M. E.,
Dean
Electrical Engineering

CLARENCE CLEVELAND CARPENTER, C. E.,
Civil Engineering

GUY HERBERT ELBIN, C. E.,
Civil Engineering

IVOR ST. CLAIR CAMPBELL, M. E., E.E.,
Mechanical Engineering

LENIX CRAIG SLEESMAN, Ph. G., Ph. C.,
Chemical Engineering

JESSE RAYMOND HARROD, B. S.,
General Inorganic Chemistry

WHITMAN S. BECKWITH, A. M.,
Higher Mathematics

JOHN THEODORE FAIRCHILD, A. M., C. E.,
Mathematics

FRANK LEWIS BERGER, A. B., B. S.,
Physics

MARTELLE ELLIOTT DAVIS, A. B., Ph. D.,
Modern Languages

CHILDE HAROLD FREEMAN, B. S.,
English

WILFORD E. BINKLEY, A. B.,
Economics

ELLAHUE ANSILE HARPER, A. M., LL. B.,
Contracts

ARNOLD RAYMOND McCOMBS, B. S., in M. E.,
Assistant in Mathematics

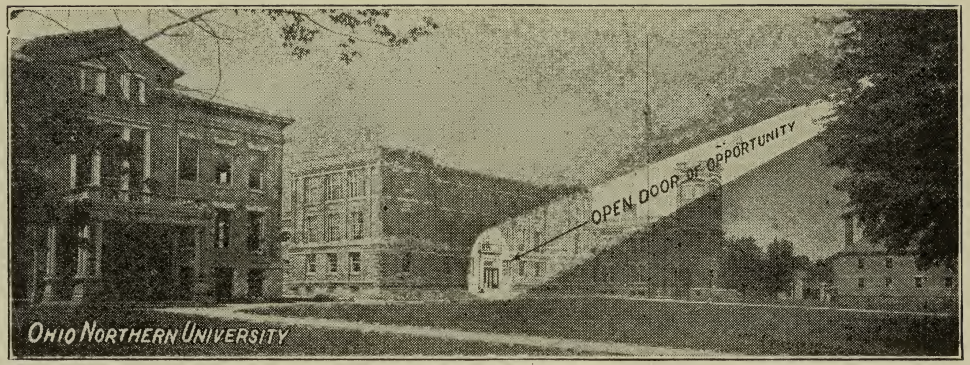
WESTON HAST THOBABEN,
Assistant in Drawing

GLEN DOANE WINANS, B. S. in M. E.,
Assistant in Mechanical Laboratory

EVERETT L. BIRD,
Assistant in Electrical Laboratory

ROBERT AMBROSE OSBORN, B. S. in Chem. E.,
Assistant in Chemical Laboratory

MERRILL R. WISEMAN, A. B.,
Assistant in Physical Laboratory



THE OHIO NORTHERN UNIVERSITY HAS FINE, NEW, UP-TO-DATE BUILDINGS:

The Dukes Memorial with commodious class rooms, offices, and laboratories, devoted to science, mathematics, engineering and agriculture.

The Lehr Memorial in which is located the executive offices, the Y. M. and Y. W. C. A. rooms, the Library with reading and research rooms, the apartments of the School of Commerce, College of Law, and a magnificent auditorium seating 1500 people.

The Hill Memorial contains ten recitation rooms, two literary societies, electrical and mechanical laboratories, and the central heating and lighting plant, In this new and magnificent building is the department of language, history, philosophy, and College of Education.

The Music Hall, nearly new, has assembly room, studios, offices and many private practice rooms.

The Pharmacy Building, recently remodeled with large laboratories, recitation rooms and Adelphian Literary society, is an attractive and valuable building.

The Brown Memorial, fitted up for a gymnasium and equipped in first-class shape for indoor athletics. A **large modernly equipped Cafeteria** together with a Domestic Science Department is connected with this building.

The Horticultural Conservatory, for the propagation and development of plants and flowers.

OHIO NORTHERN UNIVERSITY
COLLEGE OF ENGINEERING

C. R. ALDEN, Dean

The College of Engineering of Ohio Northern University occupies a unique place among the great educational institutions of America; because it is preeminently for the student of moderate means. The chief aim of this school is to place within reach of every ambitious young man or woman a complete technical training. With this end in view **the school has been divided into four quarters of twelve weeks each.** (Ohio Northern enjoys the distinction of being the pioneer institution to adopt the "quarter plan" which is becoming exceedingly popular among the important educational institutions of America.)

Courses are arranged to meet the needs of students entering at the beginning of any quarter. This practically insures every subject being presented from two to four times a year.

In almost every community, in almost every rural district, there are young men (and women also) who are devoting their time to manual labor, who through economy, have laid by a little money. They look about them and observe the advantages of an education. In earlier years they failed to use their opportunity for obtaining an education. They would now enter some school and begin at the bottom and work up if they were confident that such a school could be found. A school where they would not feel embarrassed by being forced to recite with more educated students.

No school in America has done more for this backward class than ours.

Such men, because of more mature years and industrious habits, can meet the entrance requirements in about two and one-half years in OUR PREPARATORY SCHOOL. Furthermore, the preparatory work is designed to best meet the requirements of an engineering

course. Many of our graduates are thus men of mature years who have completed both the preparatory and collegiate work in this institution at a great saving of time and money.

Note: Those who are not candidates for a degree see "Admission" on page 6.

Ohio Northern University is very cosmopolitan. It gets students from every state in the union and from many foreign countries. In the "Universal Club", an organization of foreign students, twenty-four countries are now (1921) represented.

The method of instruction is by class room work, drafting room, field, and laboratory practice.

Besides the regular course of instruction, one week in the latter part of the winter quarter, known as "Engineer's Week," is devoted to a series of lectures by prominent practicing engineers and manufacturers. This feature, we believe, originated in this institution and has since been copied by many engineering colleges.

Our engineering students are strongly advised to devote their vacations to surveying, drafting, work in factories, repair shops, electric light and railway stations, and similar work, in order to obtain commercial experience and a better appreciation of the relation of technical training to practical work.

The success of the course of training offered by the college is testified to by the very large per cent of the graduates who are engaged in occupations connected with engineering.

IT MAY INTEREST YOU TO KNOW THAT

The teachers in the College of Engineering are all men who have had considerable practical experience in engineering work as well as technical training.

OUR MOTTO

"We aim to give to students what they want, when they want it."

EXPENSES

On account of the large number of students attending Ohio Northern, the cost of living has been reduced to a minimum. Tuition is $34.00 per quarter (12 weeks) or $100.00 per year (36 weeks).

In order to insure good wholesome food and plenty of it at the

least possible cost to the student, the University has recently installed a large, **well equipped Cafeteria** in the Brown Building. This is very much more than "an eating place." With beautiful furnishings and home comforts, this is truly a happy campus "Community center." This is open to the public.

Good board in private homes, $3.50 to $4.50 per week.

Meal tickets at restaurants, $4.50 to $5.00 per week.

Dormitories the "bugbear" of students in some institutions are unknown here. Ada is strictly a school town. The citizens throw open their homes to the students. They have long been noted for their hospitality. Since a majority of the families are engaged in rooming students, the competition is sharp and prices are low. Rooms vary from $1.50 to $2.50 per week according to location and appointments.

Some schools advertise **free tuition,** but it will be found that **entrance** fees with them amount to more than tuition fees here, a fact not to be overlooked by those selecting a school, thorough, yet inexpensive.

All fees such as Matriculation, Registration, Library, Student Activity, etc., are included in tuition charges except a small maintenance fee in Laboratory and Field Work.

TIME TO ENTER

In view of the fact that we present nearly every branch of study in the College of Engineering from two to four times a year, it is possible for a student to enter at the beginning of any quarter, and start on a regular course of study. See Calendar. **This is a rare privilege. We do not know of it being duplicated anywhere.**

TIME REQUIRED

The object of the founders of the College of Engineering of the Ohio Northern University was to provide a school which would be able to furnish an engineering education with the least possible expenditure of time and money. In looking around for a solution of this problem it was deemed wise to offer courses which cover the fundamentals of engineering, and to omit subjects which do not have a direct bearing on engineering. By doing this it has been found possible for a student to do the required amount of work in ten quarters of twelve weeks each. Because we have thus shortened the engineering course quite materially, some technical schools have seen fit to

censure Ohio Northern University. They claim that a thorough knowledge of engineering can not be acquired in so short a time. We agree with them, but we also claim that a thorough knowledge of engineering can not be acquired in a four year course. Years of practice and study after graduation are required to develop one into an efficient engineer. However, in answer to their criticisms **we merely ask that you compare the number of study hours in engineerng subjects as shown in this bulletin with the hours in engineering subjects as shown in the bulletins of colleges that require four school years.**

We do not want to be understood as finding fault with these apparent long courses, which in addition to a thorough scientific training carry with them the benefits of classical culture; and to accommodate those who may thus wish to broaden their education, the excellent instruction of the Classical and Literary departments of the University are **thrown open to all engineering students, free of extra tuition.** A maximum of nine (9) **credit hours** will be allowed for advanced English or other modern languages.

ADMISSION

Fifteen units of high school work are required for admission. Units will be accepted without question from first grade high schools, academies, or preparatory schools. The acceptance of work from schools of lower rank will be determined by the entrance committee To those who cannot furnish certified credits, entrance examinations will be given the first day of each quarter. Those not desiring to earn a degree may enter any department and pursue the studies they choose, if on consultation, the head of the department is satisfied that they have sufficient preparation to pursue the work successfully. Such applicants are classified as special students. Upon completion of their work, a certificate, showing the course of study pursued and the amount of work covered, will be presented them.

The official form for "Certificate of Entrance," which may be had on application to the Entrance Examiner, should be used in all cases, in order to insure the presentation of necessary information.

ADMISSION WITH ADVANCED STANDING

A liberal policy is pursued in allowing credit for work done in other colleges. Some credit may be allowed for practical experience in drafting, surveying, and shop work. Applicants for such credit must submit a satisfactory statement from their employer, giving time of service, nature of work, name and address of employer.

DEGREES

The University is empowered to grant the customary scholastic degrees, which in the College of Engineering, are Bachelor of Science in Civil Engineering, (B. S. in C. E.); Bachelor of Science in Mechanical Engineering, (B. S. in M. E.); Bachelor of Science in Electrical Engineering, (B. S. in E. E.); and Bachelor of Science in Chemical Engineering, (B. S. in Chem. E.). Two years after graduation, upon presentation of creditable record and approved thesis the regulation degree will be conferred. The College accepts grades of equal value from other institutions of learning, but an applicant for a degree must do at least one year's work here.

One hundred and eighty (180) credit hours are required for graduation.

Two hours field or laboratory work constitute one credit hour.

Every candidate for a degree must prepare a thesis upon some technical subject, which lies within the field of the degree sought. A thesis may consist of designing, testing, constructing, research or a detailed description of some engineering project prepared wholly by the student. The subject selected must meet the approval of the Professor-in-charge. The form of the finished thesis to be in accordance with the department and the library.

The subject of the thesis must be announced at least twenty-four weeks before graduation, and the completed thesis must be submitted at least four weeks before graduation.

A candidate for a degree must comply with all regulations in force at time said degree is conferred.

A student cannot be a candidate for more than one professional degree at any one time.

GOVERNMENT

Each student is placed upon his honor. While students are assisted in forming correct habits, this it not a reform school. The opportunities and advantages of the University are offered to all who earnestly desire to develop the best in them and fit themselves for usefulness. All are treated as ladies and gentlemen until they prove themselves otherwise. Regular attendance in classes and thoroughness of work are required.

All students will be received and dismissed at the discretion of the President and the Administrative Committee.

GENERAL INFORMATION

1. Students will be accorded certain privileges in the choice of electives as outlined on pages 13-14.

2. Final examinations are held on Wednesday and Thursday of the twelfth week of each quarter. Mid-term examinations are held during the sixth week of each quarter. Written reviews may be given at any time during the quarter.

3. Special examinations for students debarred or deficient at regular examinations are held on the last Tuesday of each term. Where a successful examination would raise the number of Quarter hours above the maximum allowed, said examination will not be permissible. A fee of $2.50 is exacted for each special examination.

4. The following method of grading is in effect: Ex. (excellent), G. (good), Av. (average), P. (pass), Cn. (condition), F. (fail).

5. The "Point" System is universal throughout the institution.

One hundred and eighty (180) credit hours are required for graduation.

Also, one hundred and eighty (180) points are required for graduation. The following table shows the value of the different marks in terms of credit hours and points for each credit hour of the course:

	Ex.	G.	Av.	P.	Cn.	F.
Credit hours	1	1	1	1	0	0
Points	3	2	1	0	—1	—2

6. Attendance. Every student is required to attend every session of the classes in which he is registered. All absences shall be reported to the instructor upon a regular form furnished by the registrar. This report shall give date, class and reason for absence and must be submitted to the instructor immediately after the occurrence of the absence.

Failure to secure and execute this form will automatically debar the student from consideration by the committee.

Final action on this report will be taken by the "Attendance Committee" of which the registrar shall be chairman. The committee may or may not grant an excuse for such absence. Unexcused absences reduce the College credits one fifth (1-5) of an hour for each absence.

Unexcused absences during the two days preceding or the two days following a holiday will count double.

The "Attendance Committee" or the instructor is empowered to exclude from a course any student whom they may consider to have been absent so often as to seriously impair his class standing. Any student so excluded will be given a mark of F.

7. Before entering upon any study the student must have passed all the prerequisites to that subject.

8. The Dean may require a student to drop a part of his work at any time, if in his opinion the student is undertaking too much.

9. In case a student desires to **drop or change a course,** it must be done **within seven days after registration** in any quarter, and with the consent of his dean and professors concerned.

10. No credit will be allowed a student for work in any course, unless the election of the work is formally entered on his classification card before the work is begun.

11. After matriculation a student can not without permission of the Dean be admitted to examination in any of the courses given until he has received in the University the regular instruction in such course.

12. Fifteen hours per week is the minimum permitted, while eighteen is the maximum permitted. **Exception,** should the student's record for the preceding term show marks of G or better in at least three fourths of his work, the faculty may grant permission to carry twenty hours.

STUDENTS' TECHNICAL ORGANIZATIONS

The Ohio Northern Chapter of the American Association of Engineers holds bi-monthly meetings. All engineering students are eligible to membership. Proceedings of the American Association of Engineers are received and discussed.

The O. N. U. Society of Chemical Engineers holds meetings every two weeks. Technical papers pertaining to chemical engineering are read and chemical and metallurgical subjects are discussed. All students of chemical engineering are eligible to membership.

The Ohio Northern Branch of the American Institute of Electrical Engineers holds bi-monthly meetings. At these meetings original papers and papers printed in the Proceedings of American Institute of Electrical Engineers are read and discussed. All students interested in electrical engineering are eligible to membership.

The Ohio Northern Society of Mechanical Engineers has been organized for the benefit of those enrolled in mechanical engineering. Its meetings are held bi-monthly; at these meetings original papers relative to mechanical engineering and its various phases of work together with new developments in the field of mechanical engineering are investigated and discussed by the members of this Society.

In honor of George Washington, "Surveyor, Soldier, Statesman," the above societies devote the week of February 22 to a series of Technical Lectures, Annual Exhibit, Annual Banquet, etc.

Among the visiting lecturers of the past year were found: Mr. B. A. Gramm, vice president and general manager Gramm-Bernstein Motor Co., Lima, Ohio; Mr. H. D. Rohn, employment manager Lima Locomotive Works, Lima, Ohio; Mr. O. T. Kreusher, educational director, Delco Company, Dayton, Ohio; Professor C. E. Sherman, director civil engineering department, College of Engineering, Ohio State University, Columbus, Ohio; G. H. Gotshall, sales manager Johns-Manville Co., Cleveland, Ohio.

HATCHET ANNIVERSARY

FINANCIAL AID TO STUDENTS

The Board of Education of the M. E. Church lends money to those who are taking a course in school and have been in attendance long enough to merit a recommendation from the faculty. No interest is charged for two years from date of graduation, and no security is required further than a recommendation from a quarterly conference and from the faculty. Many of our students avail themselves of this advantage.

For further information, address Prof. H. Whitworth, Ada, Ohio, who has charge of this fund.

There is also an Employment Bureau conducted by the Y. M. C. A., whereby many of our students make their entire expenses working as waiters, janitors, and at other occupations in town, being able at the same time to carry on their studies. There is no reason why any ambitious and capable young man or woman desiring an education, should not obtain it at the Ohio Northern University.

Also, many engineering students obtain their education by attending school during the winter and spring quarters and finding employment on engineering projects during the remainder of the year.

CIVIL ENGINEERING

This is the parent stem of all engineering pursuits, and in its broader sense includes all branches of engineering. Many of its former departments have grown into separate professions, yet there still remains a broad and important field, offering greater opportunities than ever before. No sharp line of distinction can be drawn between the provinces of the civil, electrical, and mechanical engineers. This is evidenced by the large number of subjects studied in common by all the students of the various engineering departments: the basic engineering sciences, mathematics, physics, chemistry, and some applied sciences being required in all the departments.

A careful study of the schedule and of the descriptions of courses will give the prospective student a good idea of the broad field covered by our courses in civil engineering.

The subjects given in the department of civil engineering are divided into five groups. **Every candidate for B. S. in C. E. degree must take all the subjects in Group I.** No substitutions will be permitted. The candidate may then select any one of the remaining four groups in which to complete his work. It will be noticed that in each of the remaining four groups appears an item 'elective'. The student may choose these from any of the groups, or from one of the other engineering departments, or with the consent of the Dean, from one or more of the other colleges of the University.

From the foregoing it will be noticed that the student is given much latitude in the choice of his studies. Students are advised to choose electives from such subjects as law, advanced english, and political science; but are not required to do so.

Practically all local improvements are under the direct supervision of the College of Enginering. Many thousands of dollars have been expended the past few years for street paving, macadamizing, sewerage, etc., the major portion of the engineering work being done by the students themselves. A few of the many essential features which we might mention, i. e., establishing street and sidwalk grades, cross-sectioning and computing earthwork, laying out street and alley intersections, installation of sewers and accessories, inspection, specifications, advertisements, proposals and lettings.

EQUIPMENT

For the use of students in the classes in surveying and railroad engineering, the University is fully equipped with transits, levels,

plane tables, rods, tapes, etc. For classes in stresses and bridge design a large collection of photographs and a number of models of different types of bridges. The testing laboratory contains a Riehle Testing Machine, a Fairbanks Briquette Testing Machine, complete apparatus for cement testing, sets of sieves for analysis of sands and coarse aggregates, a beam testing machine, American Rattler for testing paving bricks, and apparatus for making hydraulic experiments with standard orifices and weirs. Besides, students of civil engineering have access to the laboratories of the Mechanical, Electrical and Chemical Departments.

The drafting room is being enlarged and re-equipped with more modern apparatus. Individual tables, planimeters, protractors, electric blueprinting machine, and drawing models will form part of the equipment of this room.

The following is a schedule of the course offered, showing the number of credit hours per week devoted to each subject:

FIRST QUARTER

Col. Alg. I	5
Trigonometry	5
Mech. Draw. I	4
Chem. I	4
Gym.	1

THIRD QUARTER

Col. Alg. III	3
Calc. I	4
Mech. Draw III	2
Anal. Geom. II	4
Chem. III	4
Gym.	1

FIFTH QUARTER

Calc. III	4
Physics VI	5
Field Engr.	5
Group Options	5
Gym.	1

SEVENTH QUARTER

Mech. of Mtls. II	3
Stresses I	4
Graphics	5
Hyd. II	4
Test. Mtls.	2

NINTH QUARTER

Bridge Design	3
Highways	3
Masonry	3
Group Options	9

SECOND QUARTER

Col. Alg. II	3
Anal. Geom. I	4
Mech. Draw. II	2
Chem. II	4
Physics IV	5
Gym.	1

FOURTH QUARTER

Calc. II	4
Desc. Geom. I	5
Physics V	4
Plane Surv.	5
Gym.	1

SIXTH QUARTER

Mech. of Mtls. I	5
Hyd. I	4
Geol.	3
R. R. I	5
Gym.	1

EIGHTH QUARTER

Stresses II	4
Br. Des. I	3
Rein. Conc. I	3
Water Supply	5
Group Options	4

TENTH QUARTER

Law of Contracts	5
Foundations	3
Masonry Design	3
Estimates	2
Group Options	5
THESIS	

Total Required	157
Group Options	23
	180

Physical Education credits exclusive of 180 required hours.

CIVIL ENGINEERING GROUPS

REQUIRED

GROUP I

MATHEMATICS

Coll. Alg. I, II, III	11
Trigonometry	5
Analytic Geometry I, II	8
Descriptive Geometry I	5
Calculus I, II, III	12

SCIENCE

Chemistry I, II, III	12
Physics IV, V, VI	14
Geology	3

DRAWING

Mechanical Drawing I, II, III	8

APPLIED

Graphics	5
Stresses I, II	8
Bridge Design I, II	6
Mechanics of Materials I, II	8
Hydraulics I, II	8
Water Supply	5
Masonry	3
Masonry Design	3
Reinforced Concrete I	3
Foundations	3
Testing Materials	2
Highway Engineering	3
Estimates	2
Law of Contracts	5
Plane Surveying	5
Field Engineering	5
Rail Road I.	5
	157

OPTIONS

GROUP II **General**

Railroads II	3
Reinforced Concrete II	3
Elementary Electric Machines I	5
Design of Dams	3
Irrigation and Drainage	3
Electives	6
	180

GROUP III **Sanitary**

Sewerage	3
Reinforced Concrete II	3
Bacteriology	4
Chemistry	5
Electives	8
	180

GROUP IV **Structural**

Descriptive Geometry II	2
Mill Buildings	3
Higher Structures	5
Reinforced Concrete II	3
Metallurgy	2
Electives	8
	180

GROUP V	Mathematical	
	Least Squares	2
	Geodesy	2
	Astronomy	2
	Field Astronomy	2
	Differential Equations	3
	Analytic Mechanics	5
	Electives	7
		180

ELECTIVES—Electives may be chosen from the other groups or from the other Engineering Departments or from the Colleges of Law, or Liberal Arts, or Commerce. The electing of such subjects must meet the approval of the Dean.

ELECTRICAL ENGINEERING

The courses offered in this branch of Engineering require a thorough study of theoretical and applied electricity. The first half of the prescribed study is, in the main, the same as that in the Civil and Mechanical Engineering curriculum, including the fundamental engineering sciences, mathematics, drawing and surveying.

The second half consists of courses of study in stresses, strength of materials, hydraulics, steam engine, advanced study in the theory of electricity, a large amount of laboratory research and experiment, shop tests, machine drafting and designing, power plant and wiring layouts, and a thorough course in electrical machine construction.

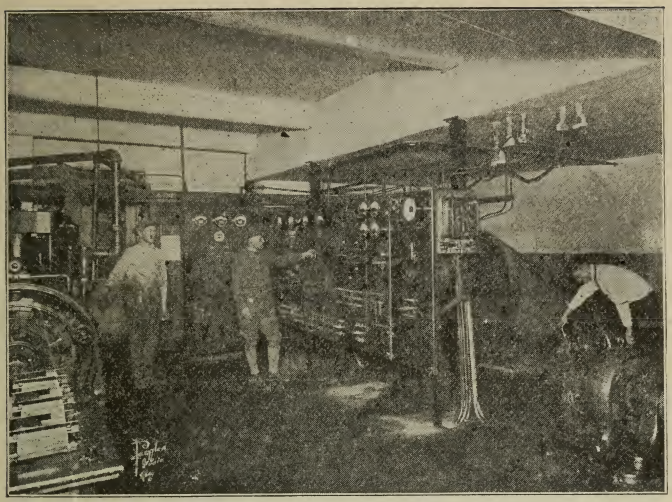
The theoretical work is thoroughly supplemented with practical application in the laboratory and in the design of electrical machinery. Throughout the course the student is drilled in the solution of many numerical problems with a view to a firm grasp of the theory.

EQUIPMENT

In addition to an excellent Physical Laboratory, the department has a well equipped Electrical Laboratory. An up-to-date oil engine-driven Electric lighting system has been installed for lighting the University buildings and grounds, and for driving the ventilating motors in the various buildings.

The University power plant comprises one gas engine unit and semi-Diesel oil unit. To prevent interruption to the service, storage batteries have been installed. These batteries are available for test and form an important addition to the laboratory equipment.

In the laboratory, both direct and alternating currents may be used for testing purposes. The many additions made recently to the laboratory equipment, and the enlargement of the laboratory, have



ELECTRICAL LABORATORY

made it possible to accommodate a **large number of students.** In addition, the machine shop with its complement of lathes and drill presses and other tools constitutes a valuable acquisition for the department. As a part of the electrical equipment the following may be mentioned: A General Electric three phase generator; a control panel with suitable switches and circuit breakers, meters, etc; a testing panel for the measuring of resistance, or testing of three phase apparatus, a feeder panel for the control of the A. C. and D. C. testing circuits, a five panel switchboard for controling the D. C. generators, motor generator sets and storage batteries, equipped with necessary meters, switches, circuit breakers, etc.; a large number of D. C. motors and generators representing the product of seven different manufacturing companies, including an iterpole motor of the latest construction; several transformers; Westinghouse, Reliance, Wagner and Emerson induction motors, both three phase and single phase; induction coils; storage batteries; Electric Tachometer; X-Ray apparatus; frequency meters; galvanometers; bridges, rheostats; watthour meters; pronybrakes and about forty voltmeters, ammeters and wattmeters, representing nearly all the best known makes of instruments. In addition to the above, the department has recently acquired two direct current generators, a twenty-five K. W. General Electric and a fifteen K. W. Westinghouse. The department is well

supplied with all the necessary equipment for the conducting of first class laboratory work. The study of Alternating Currents is made very clear by the use of a lecture room oscillograph.

The following is a schedule of the course offered, showing the number of credit hours per week devoted to each subject:

FIRST QUARTER	
Col. Alg. I	5
Trigonometry	5
Mech. Draw I	4
Chem. I	4
Gym.	1

THIRD QUARTER	
Col. Alg. 111	3
Anal. Geom. 11	4
Mech. Draw. III	2
Calculus I	4
Physics VI	5
Gym.	1

FIFTH QUARTER	
Elec. Machines I	5
Calculus III	4
Chemistry III	4
Thermo I	5
Gym	1

SEVENTH QUARTER	
E. Mach. II	3
Graphics	5
Mech. of Matls II	3
Hydraulics II	4
Mach. Design I	4

NINTH QUARTER	
E. Machines IV	4
El. Machines VII	4
El. Machines VI	4
Steam Turbines	4
Diff. Equations	3

SECOND QUARTER	
Col. Alg. II	3
Anal. Geom. I	4
Mech. Draw. II	2
Chem. II	4
Physics IV	5
Gym.	1

FOURTH QUARTER	
El. Elec. Mach. I	4
Desc. Geom. I	5
Calculus II	4
Physics V	4
Gym.	1

SIXTH QUARTER	
E. Mach. III	5
El. Elec. Mach. II	4
Mech. of Matls I	5
Hyd. I	4
Gym	1

EIGHTH QUARTER	
E. Machines V	5
Telephone Eng.	4
Plane Survey	5
Mach. Design 11	4
Seminar	1

TENTH QUARTER	
Electric Circuits	2½
Electric Railways	2½
Adv. A. C.	5
Elec. Mach. IX-a	4
Elec. Mach. IX-b	4
THESIS	

Physical Education Credits exclusive of 180 required hours.

MECHANICAL ENGINEERING

Mechanical Engineering deals with the transformation and transmission of energy, and with the theory, design, and construction of mechanism and machinery. The courses offered are selected with a view to the theoretical and practical training that will enable the student to cope with the intricate and complicated problems arising in this important phase of engineering. The first half of the curriculum consists of the basic engineering studies. In the latter half an exhaustive study is made of all phases of heat engineering, together with the design, erection, and maintenance of power plant apparatus.

Thorough training is given in machine drafting, machine designs, thermodynamics, steam engines, heating and ventilating, steam boilers, refrigeration, gas engines, electrical machinery, and steam power plants.

EQUIPMENT

The University has its own gas engine-driven lighting plant and a central steam heating plant, lighting and heating all the University buildings. This equipment is installed with special conveniences for making tests on boilers, heating apparatus and power apparatus. In addition the central heating plant of the Ada Heating and Light Co., with its equipment of Corliss engines, high pressure cold and hot water pumps, et cetera, is open to the students for inspection and test.

MECHANICAL LABORATORY

A well equipped machine shop has been added recently to the laboratory equipment, thus giving the student excellent training in the use of tools and general machine shop practice.

The University, because of increasing power demands, contemplates building in the near future a modern power plant equipped with oil and gas engines of the latest types, with a view to making it a part of the mechanical laboratory, in which tests for efficiency and fuel consumption may be easily and quickly made. The work of

installing will be done largely by student help, who thus will get practical experience in moving and erecting engines, switch boards, storage batteries, et cetera. Since the plant will be operated by student help, additional practical experience will be gained.

The following is a schedule of the course offered, showing the number of credit hours per week devoted to each subject:

FIRST QUARTER	
College Algebra I	5
Trigonometry I	5
Mech Drawing I	4
Chemistry I	4
Gym	1

SECOND QUARTER	
College Algebra II	3
Anal. Geometry I	4
Mech. Drawing II	2
Chemistry II	4
Physics IV	5
Gym	1

THIRD QUARTER	
College Algebra III	3
Calculus I	4
Mech. Drawing III	2
Anal. Geometry II	4
Physics V	4
Gym	1

FOURTH QUARTER	
Calculus II	4
Desc. Geometry I	5
Chemistry III	4
Plane Surveying	5
Gym	1

FIFTH QUARTER	
Calculus III	4
Physics VI	5
Thermodynamics	5
Elem. Elect. Mach II	4
Gym	1

SIXTH QUARTER	
Mech. of Matls. I	5
Hydraulics I	4
Steam Engines	5
Elem. Elec. Mach. I	4
Gym.	1

SEVENTH QUARTER	
Mech. of Mat. II	3
Stresses I	4
Graphics	5
Hydraulics II	4
Steam Boilers	3

EIGHTH QUARTER	
Anal. Mech.	5
Mach. Design I	4
Steam Turbines	4
Steam Power Plants	5

NINTH QUARTER	
Mech. Lab. I	3
Gas Engines	4
Heat & Vent. & Refrig.	5
Metallurgy	2
Mach. Design II	4

TENTH QUARTER	
Mech. Lab. II	4
Steam Eng. Design	5
Gas Eng. Design	5
Mach. Design III	4
THESIS	

OPTIONS—Mill Building (3) and Foundations (3) may be substituted for either Gas or Steam Engine Design in the TENTH QUARTER.

Physical Education Credits exclusive of 180 required hours.

CHEMICAL ENGINEERING

In answer to the growing demand for a course of study that will prepare the student to attack and solve the many chemical and metallurgical problems evolving from the rapid development of the industries, a course in chemical engineering has been arranged. The aim is to not only thoroughly acquaint the student with the fundamental principles of chemical science, but to afford him a complete drill in analysis and in the preparation of inorganic and organic products.

Although this department is only in its infancy, its growth has been much greater than its founders dared even hope it to be.

EQUIPMENT

The equipment for general laboratory work is composed of a full working outfit of apparatus and locker for each student. Tap water and natural gas make each desk a convenient place to work. Spacious laboratories with special arrangement for force filtering and for doing quantitative work. Equipment for special laboratory work includes a Brown furnace and burner with motor attachment, gas apparatus, (Official apparatus, United States Steel Corporation), Complete urinary analysis outfit, milk analysis outfit, balances, desiccators, generators, extractors, burettes, pipettes, Nesslers Cylinders, distilling apparatus, picnometers, thermometers, alcoholmeters, saccharometers, etc. Chemical Engineering is a young and growing department and much new equipment is added each year.

The following is the schedule of the course offered showing the number of credit hours per week devoted to each subject:

FIRST QUARTER	
Col. Algebra I	5
Trig.	5
Mech. Drawing I	4
Chemistry I	4
Gym.	1

SECOND QUARTER	
Col. Algebra II	3
Anal. Geom. I	4
Mech. Draw. II	2
Chemistry II	4
Physics IV	5
Gym.	1

THIRD QUARTER	
Col. Algebra II	3
Calculus I	4
Mech. Draw. II	2
Analyt. Geom. II	4

FOURTH QUARTER	
Calculus II	4
*Descrip. Geom. I	5
Physics V	4
Chemistry IV	5
Gym.	1

FIFTH QUARTER	
Thermo.	5
Chemistry V	5
Physics VI	5
Elem. Elect. Mach. I	4
Gym.	1

SIXTH QUARTER	
Mech. of Mat. I	5
Hydraulics I	4
Chemistry VI	5
Elem. Elect. Mach. II	4
Gym.	1

SEVENTH QUARTER	
Mech. of Mat. II	3
Hydraulics II	4
Chemistry VII	5
Graphics	4

EIGHTH QUARTER	
*Elec. Mach. I	5
Chemistry VIII	5
*Steam Eng.	4
Water Supply	4

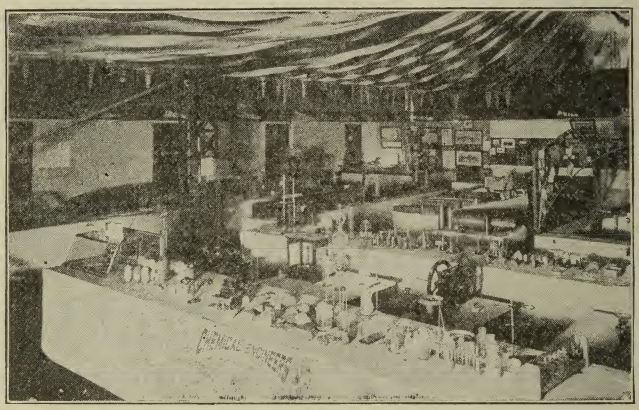
NINTH QUARTER	
Chemistry IX	5
Chemistry IX	5
*Elect. Mach. II	4
*Mach. Design I	4

TENTH QUARTER	
Estimates	2
Geology	3
Mineralogy	4
Chemistry X	5
*Storage Bat.	4
THESIS	

Twenty-five hours of the subjects marked with an * may be made optional from the following courses:

Biology I	3	Calculus III	4
Biology II	3	Anal. Mech.	5
Economics	3	Sewerage	3
Contracts	5	Heat, Vent., Ref.	5
Scient. Manag.	4	Spanish	5
Plane Survey.	5	German	5
Mechanical Lab.	3		

Physical Education Credits exclusive of 180 required hours.



A FEATURE OF THE ENGINEERS EXHIBIT

STRUCTURAL DRAFTING

This course is designed to give the students a thorough drill in "Drafting Room" practice. There are many young men who for reasons, financial or otherwise, do not aspire to the longer courses leading to a degree; but who would gladly avail themselves of the opportunity to prepare themselves to enter the busy "Structural Field." For such as these we have arranged this course, and upon completion of same a certificate will be granted, which should prove to be a valuable passport into the modern drafting room. There is no preparation other than the grades necessary to enter this course.

FIRST QUARTER

Algebra I	5
English Composition	5
Mechanical Drawing I	4
Geometry I	5

SECOND QUARTER

Algebra II	5
Geometry II	5
Preparatory Rhetoric I	5
Mechanical Drawing II	2
Physics I	5

THIRD QUARTER

Algebra III	5
Geometry III	5
Mechanical Drawing III	2
Descriptive Geometry I	5
Business English	4

FOURTH QUARTER

Algebra IV	5
Machine Drawing	4
Descriptive Geometry II	2
Graphic Statics	5
Trigonometry I	5

DESCRIPTION OF COURSES

MATHEMATICS

1. College Algebra I. 5 hours. Simultaneous Simple Equations; Graphs; Factors; Quadratics; Rational Fractions; Indeterminate Forms; Binomial Theorem; Evolution. Prerequisite: High School Algebra. Text: College Algebra, Fine.

2. College Algebra II. 3 hours. Irrational Functions; Irrational Equations; Complex Numbers; Quadratic Equations and Equations in Quadratic Forms; Graphs of Quadratic Polynomials; Ratio; Proportion; Progressions; Logarithms. Prerequisite: 1. Text: College Algebra, Fine.

3. College Algebra III. 3 hours. Permutations; Combinations; Probability; Mathematical Deduction; Theory of Equations; Cubic and Biquadratic Equations; Determinents.--Prerequisite: 1, 2. Text: College Algebra, Fine.

4. Trigonometry. 5 hours. Definitions; Trigonometric Equations and Functions; Inverse Functions; Solution of Triangles and Applications; Spherical Trigonometry with certain applications. Prerequisites: High School Algebra, Geometry and Trigonometry. Text: Plane and Spherical Trigonometry, Palmer and Leigh.

5. Analytic Geometry I. 5 hours. Loci and their Equations; straight Line; Circle; Graphs in Rectangular and Polor Coordinates; Transformations; Conic Sections. Tangents. Prerequisites: 2, 4. Text: New Analytic Geometry, Smith and Gale.

6. Analytic Geometry II. 3 hours. Parametric Equations and Graphs; Space Coordinates and Loci; The Plane; Special and Quadric Surfaces; Empirical Equations. Prerequisites: Solid Geometry; 5. Text: Same as for 5.

7. Calculus I. (Differential) 4 hours. Functional notation; Total and Partial Differentiation; Successive Differentition; Differentials; implicit and explicit functions; Convergence and Divergence of Infinite Series; Expansion of Functions; Indeterminate Forms; Maxima and Minima of Functions of one Variable. Prerequisite: 5: Text: Differential and Integral Calculus, Osborne.

8. Calculus II. (Differential and Integral) 4 hours. Change of Variable; Maxima and Minima of Functions of two or more Variables; Direction of Curves; Tangents and Normals; Tangent Plane and Normal Line; Direction of Curvature; Curvature and Radius of Curvature; Osculating Circle; Envelopes; Simple Integrations and Applications. Prerequisites: 6, 7. Text same as for 7.

9. Calculus III. (Integral) 4 hours. Integration by Parts; Reduction Formulae; Integration by Substitution; Integration as a Summation; Applications; Successive Integration and Application to Surfaces; Volumes; Moment of Inertia; Center of Gravity; Fluid Pressure; Attraction at a Point; Hyperbolic Functions; Cycloid. Prerequisite: 8. Text: same as for 8.

10. Astronomy (Descriptive) 3 hours. Reference Points and Lines: The Constellations; The Earth and its Motion; Time; the Moon; the Solor System; the Planets; Comets and Meteors; the Sun; Stars and Nebulae. Prerequisites: 4, 6. Text: Introduction to Astronomy, Moulton. Star Maps: Young.

11. Differential Equations. 3 hours. Equations of the first order and degree; Equations of the first Order, but not of the first Degree; Equations of second Order. Linear Equations with Constant Coefficients. Prerequisite: 9. Text: A Treatise on Ordinary and Partial Differential Equations, Johnson.

12. Theoretical Mechanics. 5 hours. Center of Gravity; Moment of Areas and Mass; Moment of Inertia; Ellipse of Inertia; Kinematics of a Point; Kinetics of a Material Particle; Work; Energy; Impulse. Prerequisite: 9. Text: Theoretical Mechanics, Smith and Longley.

PHYSICS

Physics 4. 5 credit hours. This course consists of class and laboratory work in mechanics. A large number of problems are solved. The texts are Kimball's Physics, and Henderson's Physics Problems. Prerequisites: Preparatory Physics, and Trigonometry. Class, three hours; laboratory, two hours.

Physics 5. 4 credit hours. (Sound, Heat and Light). Prerequisites the same as for course 4. Class, three hours; laboratory, two hours.

Physics 6. 5 credit hours. (Electricity and Magnetism). Prerequisites: Physics 4. Texts are the same as above. Class, three hours; laboratory, two hours.

The laboratory work for the above courses requires at least twelve quantitative experiments for each course. The work is based on the following texts: Millikan and Mill's. The experiments are chosen mainy from Millikan's texts.

CHEMISTRY

Chemistry I.: 4 credit hours. This is a beginner's course in General Chemistry. A thorough drill in the first principles of Chemistry is given. The non-metallic elements are studied and experiments performed in the laboratory. Text McPherson and Henderson.

Chemistry II.: 4 credit hours. This is a course in the non-metallic compounds. The class work consists of lectures, recitations and demonstrations. In individual laboratory work, each student thoroughly investigates every subject. Text: same text. Prerequisite: Chemistry I.

Chemistry III.: 4 credit hours. In this course the metallic elements, their compounds and chemical philosophy are theoretically and practically taught by lectures, recitations, demonstrations and much individual laboratory work by the student. Text: same text. Prequisite: Chemistry II.

DRAWING

1. Freehand Drawing: Sketches and pencil work.

2. Mechanical Drawing I.: 4 credit hours. Use of instruments, applied geometry, lettering and orthographic projections. Text: French Engineering Drawing.

3 Mechanical Drawing II: 2 credit hours. Developments, intersections, pictorial drawing. Prerequisites: Mechanical Drawing I. Text: French Engineering Drawing.

4. Mechanical Drawing III. 2 credit hours. Working drawings. Prerequisites: Mechanical Drawing II. Text: French Engineering Drawing.

5. Descriptive Geometry I. 5 credit hours. Advanced orthographic projections. Problems of point, line, plane and curved surfaces. Prerequisites: Mechanical Drawing III. Text Church and Bartlett.

6. Descriptive Geometry II. 2 credit hours. Shades, shadows and perspectives. Prerequisites: Descriptive Geometry I. Text: Church and Bartlett.

CIVIL ENGINEERING

1. Plane Surveying. 5 credit hours. Use of chain, level and transit. Prerequisites; Trigonometry. Text; Pence and Ketchum Surveying Manual.

2. Field Engineering. 5 credit hours. Land surveying, topographic surveying by stadia and transit, city surveying and measurements of volumes. Prerequisites; Plane Surveying. Text: Johnson and Smith.

3. Railroad Surveying. 5 credit hours. Simple curves, compound curves, reverse curves, spirals, switches and turnouts. Prerequisites; Field Engineering. Text: Searles and Ives Field Engineering.

4. Railroad Construction and Maintenance. 3 credit hours. Organization, rules, ballast, ties, rails, track design, trestles, culverts, roadway machines, work of the M. of W. department. Prerequisites: Railroad Surveying. Text: Willard, Maintenance of Way and Structures.

5. Highway Engineering. 3 credit hours. Design, construction and maintenance of earth roads, paved roads and streets. Prerequisites: Geology and Field Engineering. Text: Baker's Roads and Pavements.

6. Geology. 3 credit hours. A study of the earth's crust dealing with rock form and structure, and the formation of mineral deposits, mountain folds and faults. Prerequisites: Chemistry. Text: Chamberlain and Salisbury.

7. Sewerage. 3 credit hours. General course on sewerage systems. Prerequisites: Hydraulics II. Text: Folwell.

8. Irrigation and Drainage. 3 credit hours. History, use of water for irrigation, collecting and distributing works, construction and maintenance. Prerequisite: Hydraulics II. Text: Professor's Notes.

9. Hydraulics I. 4 credit hours. Static water pressure, flotation, buoyancy, laws of falling bodies, applied to hydraulics, measurements of flow. Prerequisites; Physics and Calculus III. Text: Merriman's Treatise on Hydraulics.

10. Hydraulics II. 4 credit hours. Flow of water not under pressure, water supply studies, water power, theory of water motors, naval hydromechanics and theory of pumps. Prerequisites: Hydraulics I. Text: Merriman.

11. Astronomy. See "Mathematics."

12. Field Astronomy. 2 credit hours. Observation and computation. Text: Comstock, Prerequisite: Astronomy.

13. Geodesy. 2 credit hours. Geodetic surveying and map making. Text: Merriman. Prerequisites: Least Squares and Field Astronomy.

14. Masonry. 3 credit hours. Natural stones, building bricks, limes, cements, sand, gravel, broken stone, lime and cement mortars, plain concrete, building blocks and artificial stones, stone and brick masonry, and ordinary foundations. Prerequisites: Mechanics of Materials I. Text: Baker's Masonry Construction.

15. Masonry Design. 3 credit hours. Plain concrete arches, bridge abutments ,and retaining walls. Prerequisites: Masonry. Text: Professor's Notes.

16. Mechanics of Materials I. 5 credit hours. General principles of stresses, elastic limit, shear, riveted joints, torsion, center of gravity, moment of inertia, stresses in beams beams with more than two supports, shears in beams. Prerequisites or concurrents: Calculus III. Text: Boyd's Strength of Materials.

16. Mechanics of Materials II. 3 credit hours. Special beams, bending combined with tension or compression, column theory, column formulas used by engineers, resilience in bending or shear, combined stresses, theory of elastic limit and failure, curved beams and hooks. Prerequisites: Mechanics of Materials I. Text: Boyd.

17. Stresses I. 4 credit hours. Dead load, snow load, wind load and live load stresses in roof trusses. Dead load, live load and wind load stresses in simple bridge trusses. Prerequisites: Mechanics of Materials I. Text: Merriman and Jacoby's Roofs and Bridges Part I.

17. Stresses II. 4 credit hours. Continuation of live and wind load stresses in bridge trusses, theory of least work, deflection of trusses, history and evolution of bridge trusses. Prerequisites: Stresses I. Text: Merriman and Jacoby's Roofs and Bridges Part I.

18. Graphics. 5 credit hours. Graphical method of combining forces, moment and shear in beams, stresses in roof trusses, due to dead, wind and snow loads, stresses in bridge trusses due to dead, wind and uniform live loads. Prerequisites: Mechanics of Materials I. Text: Merriman and Jacoby's Roofs and Bridges Part II.

19. Bridge Design I. 3 credit hours. Design of roof truss and plate girder bridge. Prerequisites: Stresses II. Text: Merriman and Jacoby's Roofs and Bridges Part III.

20. Bridge Design II. 3 credit hours. Design of steel truss bridge. Prerequisites: Stresses II. Text: Merriman and Jacoby's Roofs and Bridges Part III.

21. Higher Structures. 5 credit hours. Continuous, cantilever, draw, and suspension bridges. Three hinged arches, two hinged arches and hingeless arches. History of large bridges. Prerequisites: Bridge Design II. Text: Merriman and Jacoby's Roofs and Bridges Part IV.

22. Mill Buildings. 3 credit hours. Computation of stresses and design of modern buildings. Prerequisites: Stresses II. Text: Ketchum's Mill Buildings.

23. Reinforced Concrete I. 3 credit hours. Design of concrete beams, girders, slabs, columns and footings. Prerequisites: Mechanics of Materials I. Text: Taylor and Thompson.

24. Reinforced Concrete II. 3 credit hours. Design of concrete bridges, chimneys, arches, and retaining walls. Prerequisites: Reinforced Concrete I. Text: Taylor and Thompson.

25. Water Supply. 5 credit hours. Requisites of a water supply, quality of water, collecting and distributing works, studies of rainfall and run off, works for treating water, pumping plants. Prerequisites: Hydraulics I. Text: Folwell.

26. Testing Materials. 2 credit hours. Testing cement mortars, tests of small wooden beams and columns with deflection instrument, tension test of steel and iron with extensometer, tests for impurities in concrete aggregates, sieve analysis of concrete aggregates. Prerequisites: Mechanics of Materials I. Text: Hatt and Scofield's laboratory of Testing Materials.

27. Foundations. 3 credit hours. A descriptive course dealing with pile foundations, pile driving, sheet piling, cofferdams, open and pneumatic caissons, open wells, types of piers and abutments and underpinning. Prerequisites: Masonry. Text: Jacoby and Davis' Foundations of Bridges and Buildings.

28. Design of Dams. 3 credit hours. Gravity masonry dams, arched masonry dams, hollow masonry dams, rock fill

dams, rolled earth dams and hydraulic fill dams. Prerequisites: Masonry and Hydraulics I.

29. Estimates. 2 credit hours. Estimating quantities of material and costs of various engineering structures. Prerequisites: Can not be taken before the eighth quarter. Text: Professor's Notes.

30. Law of Contracts. 5 credit hours. See Bulletin of Law College. Can not be taken before the sixth quarter.

ELECTRICAL ENGINEERING

1. Elementary Electric Machinery I. 4 credit hours. For M. E. and C. E. students, for first year E. E. students. D. C. Generators and Motors, Train Lighting, Storage Batteries. Text: Gray's Principles and Practice of Electrical Engineering. Prerequisites: Plane Trigonometry; Physics VI. for M. E. and C. E. students.

2. Elementary Electric Machinery II. 4 credit hours. Continuation of course 1. Alternating current circuits, alternators, transformers, induction motors, transmission, illumination. Text: Gray's Principles and Practice of Electrical Engineering. Prerequisite: Elementary Electric Machinery I.

3. Electric Machinery I. 5 credit hours. (D. C. Generators). Physical theory, construction, magnetization curve, reactions, windings, operating characteristics, Problems. Text: Langsdorf's Principles of Direct Current Machines. Prerequisites: Elem. Elec. Machinery I., Calculus I.

4. Electric Machinery II. 3 credit hours. (D. C. Motors) Commutation, reaction, efficiency, rating, heating, problems. Text: Langdorf's Principles of Direct Current Machines. Prerequisites: Electric Machinery I.

5. Electric Machinery III. 5 credit hours. (D. C. Laboratory): Experimental work with direct current instruments, circuits, generators and motors. Text: Wilson's Dynamo Laboratory Outlines. Prerequisites: Electrical Machinery I., II.

6. Electric Machinery IV. 4 credit hours. (D. C. Design) Critical study of the direct current generator with special reference to design, design of a large direct current generator. Text: Gray's Electrical Machine Design. Prerequisites: Electrical Machinery I., II.

7. Electrical Machinery V. 5 credit hours. Theory of alternating current circuits. (Six weeks). Text: Sheldon's Alternating current Machinery, Vol. II. Problems, Alternating current circuits (six weeks) Lyon's Problems in Electrical Engineering. Prerequisites. Elem. Elect. Mach. II, Elect. Mach. I, II.

8. Electrical Machinery VI. 4 credit hours. (Transformers) Theory and operation (Electrical transmission) high and low tension transmission, construction and costs. Texts: Sheldon's Alternating Current Machinery Vol. II., Taylor's Transformer Practice, Still's Electric Transmission. Prerequisite: Electric Mach. V.

9. Electric Machinery VII. 4 credit hours. (A. C. Alternators, A. C. Motors, Sychronous and Induction) Theory, construction, diagrams, design. Text: Baily's Induction Motors, Sheldon's Alternating Current Machinery Vol. II. Prerequisite: Elec. Mach. V.

10. Electric Machinery VII. 4 credit hours. (A. C. Design) Design of an alternator. Text: Gray's Electrical Machine De-

10. Electric Machinery VIII. 4 credit hours. (A. C. Design)

11. Electric Machinery IX. 4 credit hours. (a) (A. C. Laboratory) Resistance, capacity, induction in A. C. circuits, lectures, problems. Text: Wilson's Dynamo Laboratory Outlines. Prerequisites. Electric Machinery VI. and VII.

12. Electrical Machinery IX. 4 credit hours. (b) (A. C. Laboratory) A. C. Machines, Tests on sychronous machinery, lectures, problems. Text: Wilson's Dynamo Laboratory Outlines. Prerequisites: Electric Machinery IX.-a.

13. Alternating Currents. 5 credit hours. Advanced theory, vector analysis, complex notation. Problems. Texts: Bedell and Crehore's Alternating Currents. Lyon's Problems in Electrical Engineering. Prerequisite: Electric Mach. VI., VII.

14. Electric Railways: 2½ credit hours. Traffic studies, surveys, probable earnings, construction, heavy main line electrification. Hardings Electric Railway Engineering, Current Periodicals. Prerequisites: For C. E. students: Elementary Electric Machinery I., for E. E. students Electric Machinery VI. and VII.

15. Electric Circuits. 2½ credit hours. The more difficult A. C. circuits. Problems. Text: Karapetoff's Electric Circuit. Prerequisites: Electric Machinery VI. and VII.

16. Electric Meters. Theory, construction, testing, calibration. Text: Jansky's Electrical Meters. Prerequisites: Elementary Electric Machinery II.

17. Storage Batteries. Chemical Theory, construction, boosters. Text: Lyndon's Storage Battery Engineering. Prerequisites: Chemistry II., Electric Machinery II.

18. Telephone Engineering. Circuits, apparatus, central office equipment, cable plant, inspection trip, tests in laboratory. Prerequisites: Physics VI., Elementary Electric Machinery I.

19. Electric Power Plant Engineering. Power plant layouts, switch gear operation. Prerequisites: Electric Machinery VI.

MECHANICAL ENGINEERING

1. Thermodynamics I. 5 credit hours. Theory of heat, laws of dynamics, perfect gases, saturated vapors, superheated vapors. Text: Cardullo's Thermodynamics (First Edition, Impression-corrected.) Prerequisites: Calculus II., First Year Physics.

2. Steam Engines. 5 credit hours. Steam and compound engines, engine testing, engine economy, condensing machinery, combustion, boiler plant auxiliaries, water cooling apparatus, compressed air, evaporation and drying, kinetic theory of heat. Text: Cardullo. Prerequisite: Thermodynamics I.

3. Steam Boilers. 3 credit hours. Types of boilers, flue and fire tube boilers, water tube boilers, boiler calculations, effects of heat, fuels, chemistry of combustion, methods of firing, chimneys and draft, boiler feed waters, inspection and care of boilers, boiler testing. Text: Parsons (Fifth Edition) Prerequisites: Thermodynamics I.

4. Steam Power Plants. 5 credit hours. Elementary steam power plants, coal and ash-handling systems, feed water purifiers and heaters, pumps, piping and pipe fitting, typical modern isolated stations. Text: Gebhardt's Steam Power Plant Engineering. Prerequisites: Steam Boilers, Thermodynamics II.

5. Steam Turbines. 4 credit hours. Velocity and flow of steam, flow of steam through orifices, turbines, reaction turbines, impulse-reaction turbines. Text Moyer's Steam Turbines. Prerequisite: Thermodynamics II.

6. Gas Engines. 4 credit hours. Liberation of heat energy, combustion, gas engines burning gas, engines using kerosene oil, gas engines using gasoline, automobile engines, ignition carburetion testing. Text: Streeter's Internal Combustion Engines. Prerequisite: Thermodynamics II.

7. Gas Engine Design. 5 credit hours. Inertia of reciprocating parts, net effort diagrams, rotative effort diagrams, weight of flywheel, construction of flywheel, velocity and displacement diagrams, cylinders, cylinder covers, frames, vaves, vave gears, the crankshaft. Text: Streeter's Internal Combustion Engines. Prerequisites: Gas Engines.

8. Mechanical Laboratory I. 3 credit hours. Laboratory work in heat measurements, determination of moisture in steam, measurements of areas, engine indicators and reducing motions, measurement of power, calorific value of fuels. Text: Moyer's Plant Testing. Prerequisites: Thermodynamics II.

9. Mechanical Laboratory II. 4 credit hours. Steam and gas engine tests, power plant tests, methods for correcting steam engine and steam turbine tests to standard conditions, flue gas analysis. Text: Moyer's Power Plant Testing. Prerequisite: Gas Engines.

10. Machine Design I. 4 credit hours. Mechanisms, motion and velocities, kinematic chains, instantaneous centers, velocity diagrams, parallel and straight line motion, cams, gearing, bevel gears, gear trains, belting, intermittent motions. Text: Sibley's Pure Mechanism. Prerequisites: Machine Drawing.

11. Machine Design II. 4 credit hours. Materials frames, cast iron beams, wheel rims, cyclinders, helical springs, journal bearings, roller bearings, punch and shear details. Text: Benjamin and Hoffman's Macine Design. Prerequisite: Machine Design I.

12. Machine Design III. 4 credit hours. Study of the toggle-joint press, alternate designs, vertical hand-power, vertical foot-power press, small hand-power press, hand-power punch and shear, belt driven punch and shear, bevel shear, the bulldozer, sheet metal flanger and disc cutter, Moyer's air hoist, riveters. Text: Benjamin and Hoffman's Machine Design. Prerequisite: Machine Design II.

13. Metallurgy. 2 credit hours. Properties of metals, processes and apparatus, mechanical metallurgical operations, ores, ore crushing, the roasting of ores, metallurgical operations, gases, air supplies. Text: Rhead's Metallurgy. Prerequisite Chemistry II.

14. Heating, Ventilating and Refrigeration. 5 credit hours. Heat, heat losses from buildings, different methods of heating, properties of steam, radiators, steam boilers, steam heating systems, pipe fittings, valves, and accessories, steam piping, hot-water systems, automatic temperature control, air and its properties, ventilation, hot-air furnace heating, design of fan systems, airwashers and air conditioning, fan systems for various types of buildings, central heating. **Refrigeration:** Cold and its production, commercial systems of refrigeration, compression systems, ice making systems, the installation and operation of refrigerating system, capacity of refrigerating machines, cold storage duty. Text: Allen and Walker's Heating and Ventilation. Prerequisite: Thermodynamics II.

15. Valve Gears. Valve diagrams, use of valve diagrams port openings, passage areas, forms of slide valves, shaft governors, valve setting, design of slide valves with riding cut-off, pump valves, reversing gears, corliss valve gears, poppet valve gears. Text: Fessenden, Valve Gears. Prerequisite: Machine Design II.

16. Steam Engine Design. 5 credit hours. Design of ports, cylinders, connecting rods, expansion ratios, receivers, multiple expansion engines, tandem compound, cross compound, three cylinder compound angle compound, duplex compound, Wolff compound, engines. Text: Klein's Design of a High Speed Engine. Prerequisite: Thermodynamics II. Machine Design II.

17. Machine Shop. Screw threads, cutting screw threads, pipe and pipe threads, twist drills and taps, calipering and fitting, standard jig parts, horsepower, belts and shafting, steam hammers and drop forging, dictionary of shop terms. Text: Colvin and Stanley. American Machinist's Handbook.

THE ANNUAL INSPECTION TRIP

The Senior Class as a whole devotes one week to an extended visit to some large commercial center. The odd year class spends every minute profitably in the study of the various phases of engineering and industrial activity in Chicago, Gary, and Fort Wayne. The even year class does the same in Pittsburgh and vicinity.

POSITIONS

Our experience in the past has been that the demand made upon the College of Engineering for graduates has been far in excess of the supply. Many employers insist on us granting concessions whereby our men can get away at the earliest moment to report for duty. The question is asked us sometimes whether we guarantee to secure positions for our graduates. This question we must answer in the negative, as no responsible school can afford to make such a guarantee.

There is not to our knowledge, a single graduate (since the department was founded) who is not holding a good position.

COLLEGE OF ENGINEERING
CLASS OF 1921

McCombs, A. R._____President Osborn, R. A.___Vice President

CIVIL

Augsburger, Clyde____ _____Beaverdam, O.
Ackerman, G. D._Lafayette, O.
Balyard, Russell___Convoy, O.
Cohen, P. L.___Newburgh, N. Y.
Dunn, J. K._New Brighton, Pa.
Duff, R. E._____Canton, O.
Hart, W. M._____Peninsula, O.
Hall, D. E._____Hamilton, O.
Harmon, J. H._____Ada, O.
Kowaless, M. H._Duquesne, Pa.
Kagaoan, Juan_ __Phillippines
Kair, W. E.__Mill River, Mass.
Leonard, E. N._____ _____Huntington, W. Va.
Lindberg, C. E._____ ____Amityville, N. Y.
LeVine, A.___Newburgh, N. Y.
Marx, Lester__Rochester, N. Y.
Ottoni, A._____ _____Brazil
Reidy, George__Buffalo, N. Y.
Ringer, S. A._____Canton, O.
Rivera, A._____ __Phillippines
Steen, P. P._____Trenton, N. J.
Samuels, C. Z.___Utahville, Pa.
Spilka, A. C._____Cleveland, O.
Siegel, H. S.__Newburgh, N. Y.
Small, R. F.___Johnstown, Pa.
Vazquez, R. L._____Mexico
Wong, S. C._____China

ELECTRICAL

Erdman, E. A.__Augusta, Wis.
Fonseca, P. Q._____Brazil
Heil, R. W._____Findlay, O.
Elder, M. E._____Ada, O.
Ely, H. A._____Akron, O.
Ignarra, O. B._____Brazil
Nogueira, M. S._____Brazil
Newmeyer, J. H._Duquesne, Pa.
Pugh, M. G._____Bradford, O.
Peterman, H. A._____ _____Cochranton, Pa.
Pierce, A. E._____Walton, N. Y.
Ronk, H. D._____Wallkill, N. Y.
Rice, Paul_____New Phila., O.
Sherman, D. C._____Arcadia, O.
Schaaf, R. D._____Arlington, O.
Schoonover, Merritt C._Ada, O.
Taylor, O. C._____Arcadia, O.
Tabares, J. D._____Cuba
Ulrey, J. W._____ Howard, O.
Veverka, F._____Bayport, N. Y.
Walker, C. E.__Jamestown, O.

MECHANICAL

Blose, H. S.____Greenville, Pa.
Busick, H. G.__Grover Hill, O.
Breesmen, W. H._Youngstown
Duff, R. M._____Canton, O.
Edwards, G. N.____Utica, N. Y.
Frank, H._____Brooklyn, N. Y.
Farstad, R. F.___Boston, Mass.
Kuhns, S. R._Ramsaytown, Pa.
McCombs, A. R._____Ada, O.
Montaras, B._____Argentine
Monseguer, J. E._____Cuba
Proner, D. A._____Bronx, N. Y.
Porter, E. E._____Niles, O.
Slonaker, J. A._Avonmore, Pa.
Winans, Glenn D._____Ada, O.

CHEMICAL

Alba, A. _____ Phillippines
Gary, H. J. _____ Ashtabula, O.
Hair, A. G.__Bridgeport, Conn.
Hersh, T. R.___Continental, O.
Litzenburg, L. C. _____ _____Centerburg, O.
Loehr, C. E.__Bellefontaine, O.
Mazzulla, Michael_____ _____Newburgh, N. Y.
Moas, M._____ _____ Cuba
Osborn, R. A.____Van Wert, O.
Seitz, S. B.____Blanchester, O.

UNIVERSITY BULLETIN
Published in June, July, September, November, January, April and May by the Ohio Northern University, Ada, Ohio. Entered as second-class matter July 2, 1907., at the postoffice at Ada, Ohio, under the Act of Congress on July 16, 1894.

SCHEDULE OF CLASSES

HOUR	PROFESSOR	FALL	WINTER	SPRING	SUMMER
7:00	CARPENTER	Mech. Draw. I	Mech. Draw. II	Mech. Draw III	Irrigation & Drainage
	ELBIN	Sewerage	Mech. Draw I	Mech. Draw. II	Graphics
	ALDEN	Tel. Eng.	El. Mach. VI	El. Rwys.	Mech. Draw. III
				El. Circuits	
	CAMPBELL	Thermo	Steam Eng.	Mach. Des. III	
	FAIRCHILD	Geometry IV			
	BERGER				Physics VI
	STAUFFER		Geology		
8:30	CARPENTER	Rein. Conc. I	Rein. Conc. II	Testing Mtls.	Des. of Dams.
				Mill Bldgs.	
	ELBIN	Mech. of Matls. I	Mech. of Matls. II	Mech. of Matls. I	Mech. of Matls. II
			Desc. Geom. II		
	ALDEN	El. Mach V		Adv. A. C.	El. El. Mach. II
	CAMPBELL	Mach. Des. III	Metallurgy	Steam Boilers	Mach. Des. I
	BERGER	Physics IV	Physics VI	Physics VI	
	SLEESMAN	Qual. I	Qual. II	Phys. Chem.	Qual. I
	HARROD	Chem. I	Chem. II	Chem. III	Chem. I
	BECKWITH	Anal. Geom. II	Trig. I	Anal. Geom. I	Anal Geom. I
9:30	CARPENTER	Stresses II	Stresses I	Stresses II	Stresses I
	ELBIN	Desc. Geom. I	R. R. II	Desc. Geom. I	Masonry
	ALDEN	El. El Mach I	El. Mch. IV	El. El. Mach. I	
	CAMPBELL	Steam. Turb.	Mach. Des. II	Mach. Des. III	
	BERGER	Physics V	Physics IV	Physics V	Elective
	SLEESMAN	Sp. Chem. Anal. I	Sp. Anal. II	Ind. Chem.	
	HARROD	Chem II	Chem. III	Chem. I	Chem. II
	BECKWITH	Anal. Mech.	Diff. Equation	Astronomy	Elective

10:30	CARPENTER ELBIN ALDEN CAMPBELL HARROD BECKWITH SLEESMAN	Hydraulics I El. Mch. I Ht., Vent., & Ref. Chem. II Calculus I Sp. Anal. I	Hydraulics II Masonry El. El. Mch. II Gas. Engines Chem. I Calculus II Sp. Anal. II	Hydraulics I Masonry Des. Chem. II Calculus III	Hydraulics II El. Meters Stm. Pow. Plts. Chem. III Calculus I
1:00	CARPENTER ALDEN CAMPBELL SLEESMAN BECKWITH FAIRCHILD	Br. Design I El. Mch. III & IX Mch. Des. I Organic I Calculus II Col. Alg. I	Test. Matls. Stm. Pow. Plts. Organic II Calculus III Col. Alg. II	Br. Design II El. Mch. III & IX Gas. Eng. Des. Quantitative I Calculus I Col. Alg. III	 El. Mch. I Quantitative II
2:00	CARPENTER ELBIN ALDEN CAMPBELL SLEESMAN BECKWITH FAIRCHILD HARROD HARPER	Water Supply Plane Survey Cl. TTh—Fld. MWF RR Survey Cl. MWF—Fld. TTh El. Mch. III & IX Organic I Trig. I Col. Alg. III Prep. Phys. I Contracts	Highway Engr. Field Engr. Class—MWF Field—TTh El. Mch. VII Organic II Anal. Geom. I Col. Alg. I Prep. Phys. II	Foundations Estimates RR Survey Cl. MWF—Fld. TTh Plane Survey (See Fall Quarter) El. Mch. III & IX Gas. Engine Des. Qualitative I Anal. Geom. II Col. Alg. II Prep. Phys. III	Test Mtls. Field Engr. Class—MWF Field—TTh El. Pow. Plts. Gas. Eng. Elective Trig. I Col. Alg. I
3:00	CARPENTER ELBIN ALDEN CAMPBELL	 Surveying El. Mch. III & IX Mech. Iab. I	Hgr. Structures Graphics El. Mch. VI Mech. Lab. II	 Surveying El. Mch. III & IX Stm. Eng. Des.	 El. Mch. VII Thermo
4:00	CAMPBELL			Stm. Eng. Des.	Heat, Vent. & Ref.

A student can start at the beginning of any quarter and make his schedule conform to that recommended at close of Description of Departments, in the course of two or three quarters. Other classes are organized when requested by a sufficient number of students to justify their organization.

DUKE'S MEMORIAL

THE SCHOOL THAT MAKES SUCCESSFUL MEN
WHAT IS YOUR AMBITION?

If it is political preferment we want to tell you about our two Supreme Court Judges, one U. S. Senator, five U. S. Congressmen, and scores of state representatives and county prosecutors.

If it is in the religious realm we call your attention to the many men we have in the high councils of the Church.

If it is in the great field of nature allow us to tell you about some of our successful scientists.

If it is technical in nature we can refer you to our engineers and pharmacists the world round, many of whom have gained prominence.

If it is in the business world we invite your investigation of our successful business men who are found everywhere.

If it is in the educational world we want to call your attention to the scores of City and County Superintendents, Principals of High Schools and members of various college faculties who have gone from here.

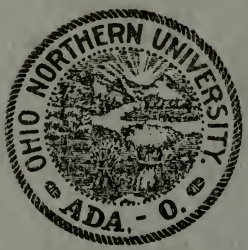
Among our Musical Alumni can be found men and women in the foreground of America's musical artists.

We have graduates holding prominent places in the fields of Agriculture, Fine Arts, and Dramatics.

The school that saves you $1000 and one year's time.

Catalogues and special literature upon request.

3 0112 105794603



FOUNDED 1871

PUBLISHED BY THE
OHIO NORTHERN UNIVERSITY
ADA, OHIO